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RESPONSE OF INDIVIDUAL PONDEROSA PINE TREES TO FERTILIZATION

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by

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ABSTRACT

Circular 1/10-acre areas in thinned stands were fertilized with nitrogen in northeastern Oregon and with nitrogen, phosphorus, sulfur, and boron in three central Oregon locations. Diameter and basal area growth of test trees at the center of these treated areas were substantially increased by fertilization. Height growth was also increased by fertilization except where top damage apparently confounded results. Fertilization significantly increased volume growth except in the central Oregon area with the lowest effective moisture, and even here the response was rather large. These results for individual trees indicate the necessity of further study to determine the kinds and amounts of elements necessary to produce maximum response on an area basis and the duration of these responses.

Keywords: Fertilizers, ponderosa pine, tree increment measure.

INTRODUCTION

Diameter and height growth of sapling ponderosa pines can be accelerated on certain sites by thinning some trees and removing understory vegetation (Barrett 1970). The increased growth caused by these cultural treatments is probably a result of increased water and nutrients available to the remaining trees. Therefore, we can speculate that fertilization might increase production of usable wood in ponderosa pine stands.

There is little information about fertilization of ponderosa pine stands. Mosher (1960) conducted an irrigation and fertilization experiment in a 90-year-old ponderosa stand in eastern Washington. Fertilizer was ammonium nitrate (33.3 percent N) applied at the rate of 66.6 lbs N/acre. Some plots were not irrigated, some were irrigated once, and others twice during the growing season. Apparently, the amount of water supplied per irrigation was 7 area inches. Mosher found the following increases in diameter growth over controls for a 2-year period:

	Percent
Fertilized only	29
Irrigated only	76
Irrigated once and fertilized	127
Irrigated twice	139
Irrigated twice and fertilized	94

Wagle and Beasley (1968) fertilized thinned ponderosa pine in Arizona with 75 lbs N/acre (NH_4NO_3), 150 lbs of P_2O_5/acre ($CaH_4(PO_4)_2$), 5 lbs/acre Fe, 2.5 lbs/acre Zn, 2.5 lbs/acre Mn, 1.25 lbs/acre Cu, and 2.5 lbs/acre Bo. Fe, Zn, Mn, and Cu were applied together in a chelated form. At the end of 2 years, added nutrients appeared to inhibit height growth and stimulate radial growth.

Youngberg (1968) applied nitrogen at the rate of 200 lbs/acre to plots in a dense ponderosa stand in central Oregon and to plots in an adjacent stand thinned to a 12- x 12-foot spacing. Five years after treatment, increases in basal area per acre were:[1]

	Percent
Unfertilized unthinned	19
Fertilized unthinned	25
Unfertilized thinned	35
Fertilized thinned	50

Agee and Biswell (1970) applied a total of 4,450 lbs/acre ammonium sulfate (934 lbs N/acre) in nine equal applications over a 3-year period to thinned and unthinned ponderosa pine stands in northern California. For the 12-year period following initial fertilization, increases in basal area growth per acre were:

	Percent
Unfertilized unthinned	8.2
Fertilized unthinned	45.9
Unfertilized thinned	82.8
Fertilized thinned	134.1

Barrett and Youngberg (1970) reported that 11.4 ounces of magnesium ammonium phosphate fertilizer placed in the planting hole increased leader growth of ponderosa pine in central Oregon. However, the increase in leader growth over the controls (10 inches in 7 years) was not large.

Personnel at Weyerhaeuser's Klamath Falls tree farm recently

[1] Data in the text were obtained by personal communication with Dr. Youngberg, Oregon State University, Corvallis.

began fertilizing thinned ponderosa pine with 200 lbs N/acre (urea). This decision was based on success the company has had with fertilization in the Douglas-fir and southern pine regions and with trials on the Klamath Falls tree farm.[2]

The purpose of my studies reported here was to determine the response of height and diameter growth to fertilization for small saw-log and pole-sized ponderosa pine in thinned stands. The first study was conducted in the Sumpter Valley in northeastern Oregon, and the second study was conducted in three central Oregon locations.

THE SUMPTER VALLEY STUDY

Location and site description.--The first study was located on a terrace just above the floor of the Sumpter Valley in the SW 1/4 of sec. 10, R. 37 E., T. 10 S., 17 airline miles west-southwest of Baker, Oregon, at an elevation of 4,200 feet. The loam soil on the terrace has A1 and A3 horizons each 7 inches thick over a B horizon that extends to a 40-inch depth. From 40 to 50 inches, the soil is gravelly clay loam; and at 50 inches, unconsolidated rock is present. A partial physical and chemical analysis of the soil is given in table 1. Understory vegetation is predominately pinegrass with small amounts of bitterbrush. The stand was 64 years old at the time of thinning in 1967. Trees selected for study within the stand averaged 51 feet in height and 10.0 inches in diameter.

Methods.--This study was installed before thinning in November 1967 during a time when foresters were concerned about influence of slash decomposition on availability of soil nitrogen. Eight groups of three dominant or codominant trees were selected within the quarter section. The terrace sloped slightly to the north and east, and there was an abandoned irrigation canal running through the area. Tree groups were chosen so that each tree within the group was on the same slope and aspect and was the same distance from the canal.

Treatments equivalent to 0, 200, and 400 pounds of nitrogen per acre were randomly assigned to each tree within each group. Fertilizer (urea, 45-0-0) was applied to a circular 1/10-acre plot with the test tree at the center. Heights of each tree were measured with a transit from a permanently staked location, and breast heights were marked with aluminum nails and diameters measured. The entire stand was thinned to a 15- x 15-foot spacing by Ranger District personnel during the winter of 1967-68, and the slash was tomahawked[3] 2 years later. Height was remeasured after four growing seasons. In

[2]This information was obtained from a letter dated September 21, 1972, from B. Z. Agrons, Timberlands Manager, Weyerhaeuser Company, to Earl E. Nichols, Supervisor, Deschutes National Forest.

[3]Tomahawking is a method for reducing fire hazard in slash by mechanical crushing with an instrument called a "Tomahawk" mounted on the front of a crawler tractor (Dell and Ward 1969).

addition, increment borings were made on the north, east, south, and west sides of each tree; and measurements were made of the radial growth of each core for 4 years before thinning and 4 years after thinning. Height growth measurements were subjected to analysis of variance. Diameter growth determined from cores was subjected to analysis of covariance, with growth for 4 years previous to treatment as the covariant.

Basal area growth for the 4-year period was determined from the data obtained from the increment borings. Bark thickness was assumed to remain the same for the period. Percent basal area growth was also subjected to analysis of covariance, with initial basal area as the covariant.

Volume growth was also estimated for each tree for the study period. Volume at the start and end of the period above a 1-foot stump was estimated by using the equation

$$\text{Volume } (ft^3) = 0.53 + 0.0017163D^2H \qquad (1)$$

where D is the diameter outside bark at 4.5 feet and H is total height. D at the end of the period was determined by taking the diameter growth determined from increment borings and adding this growth to the starting diameter. Equation 1 was obtained from dendrometer measurements of 457 trees in another study located approximately 15 miles south of Bend, Oregon. The equation accounted for 96.8 percent of the variation in volume among these individual trees. These 457 trees encompassed the size range of the trees in the Sumpter Valley study, but to use the equation to determine the volume growth the following assumptions were made:

(1) Bark thickness and form for trees from these different areas are identical.
(2) Thinning and fertilization did not result in form changes.

Estimated percent volume growth was subjected to analysis of covariance with initial volume as the covariant.

Results.--Average height growth per year for the control and two levels of nitrogen application was:

Treatment	*Height growth*	*Range*
	Feet	
Control	0.42	0.05-0.65
200 lbs/acre	.71	.42-1.0
400 lbs/acre	1.00	.35-2.2

Effect of treatment was significant at the 1-percent level.

Diameter, basal area, and volume growth per tree for 4 years after thinning were increased by fertilization (table 2). However, differences in these growth rates between the 200- and 400-pound application rates were not significant.

THE CENTRAL OREGON STUDY

Locations.--Available soil water is one of the factors limiting growth of ponderosa pine over much of its natural range. Therefore three different areas with plant communities indicating differences in effective moisture (Dyrness and Youngberg 1966) were chosen for study in central Oregon.

The area thought to have the highest amount of annual precipitation is located along Road 1808 in the SE 1/4 of section 7, R. 9 E., T. 21 S., 27 airline miles southwest of Bend, Oregon. Elevation is 4,400 feet. The soil (Lapine series) is developed from Mazama pumice and has a sandy loam A1 horizon 2 inches thick, a sandy loam AC horizon extending to 14 inches, and a C1 horizon extending to 30 inches. There is approximately 50-percent mixing in the C horizon with material from the AC horizon and from the older buried loam soil beneath. Roots are concentrated in the A1 and AC horizons, although roots are found throughout the 30 inches of Mazama material. A partial physical and chemical analysis of the soils at all three locations is given in table 3. Topography is very gently rolling. Trees were thinned in the winter of 1962-63 when 62 years old to a 12- x 12-foot spacing. The soil surfaces are covered with heavy slash, and there is little understory vegetation. Apparently the present stand is a seral stage in the *Abies concolor/Ceanothus velutinus* habitat type. In nearby areas where understory occurs, snowbrush is the predominant shrub, and true firs occur where fire has been excluded for a sufficient length of time. Average diameter and height of the dominant and codominant trees selected for study in 1969 were 14.6 inches and 65.4 feet.

The area picked as intermediate in precipitation is within the Pringle Falls Experimental Forest (SW 1/4 section 25 and the NW 1/4 section 36, R. 9 E., T. 21 S.) on a gentle to moderate slope (less than 10 percent) on a north aspect at an elevation of approximately 4,400 feet. This location is about 4 airline miles southeast of the Road 1808 area. Pumice is about 30 inches deep here, and the appearance of the Lapine soil profile is almost identical to the profile in the Road 1808 area except that the lower boundary of the AC is 2 to 4 inches shallower. About 50-percent mixing occurs in the C horizon. The buried soil is a sandy loam. The stand was thinned to a 14- x 14-foot spacing in the winter of 1961-62 when 72 years old. Heavy slash is present in parts of the area with an understory consisting primarily of snowbrush but with some bitterbrush, manzanita, and needlegrass also present. The habitat type is *Pinus ponderosa/Ceanothus velutinus-Purshia tridentata.* Average height and diameter of the individual dominant and codominants chosen for study in 1968 were 52.1 feet and 10.2 inches.

The study area with the lowest precipitation is located 6 miles south of Bend (W 1/2 of section 6, R. 12 E., T. 19 S.) on the Fort Rock Ranger District at an elevation of about 4,100 feet. The topography is gently rolling. The soil (Shanahan series) has a sandy loam A1 horizon 2 inches thick, a sandy loam AC horizon 8 inches thick, and a 20-inch C horizon consisting of Mazama pumice and ash which has apparently been reworked after initial deposition by wind and water. The buried soil is a loam containing a very high volume of basalt rock. Roots are concentrated in the A1 and AC horizons, although roots are found throughout the upper 30 inches.

Thinning took place in the winter of 1961-62. The stand age is variable, and trees are residuals left after railroad logging in the 1920's and subsequent natural reproduction. Some 2- to 10-acre openings exist in the area which have not restocked since logging. Tree spacing now ranges from a minimum of 10 x 10 feet upward. Slash concentrations are light, and the main components of the understory vegetation are bitterbrush, needlegrass, and fescue with occasional snowbrush and manzanita. The habitat type is *Pinus ponderosa/Purshia tridentata/Festuca idahoensis*. Average tree height and diameter for dominant and codominant trees chosen for treatment in this area were 47 feet and 12.2 inches.

Methods.--For the Road 1808 and Pringle Falls locations, 24 trees were selected at each location and placed into eight groups according to d.b.h. Then trees of each group were randomly chosen for a control and for one of two levels of fertilizer application.

In addition to nitrogen fertilizer, phosphorus, sulfur, and boron were also applied. Youngberg and Dyrness (1965) found that ponderosa pine seedlings responded to N, P, and S in greenhouse tests using soil developed from Mazama pumice. In addition, there was some indication that small boron additions might also increase growth (Dyrness 1960, p. 181). Estimation from the data of Youngberg and Dyrness (1965) indicated that reasonable balance would be equivalent to application rates of 200, 100, and 30 lbs/acre of elemental N, P. and S. Unpublished data for a field trial by Youngberg (see footnote 1) indicated that 1.88 and 3.75 pounds of elemental boron per acre would also be in balance with amounts of N, P, and S to be added. The three treatments were:

N0: control

N1: 200 lbs/acre N, 100 lbs/acre P, 30 lbs/acre S, 1.88 lbs/acre B

N2: 400 lbs/acre N, 200 lbs/acre P, 60 lbs/acre S, 3.75 lbs/acre B

Nitrogen was applied in the form of ammonium nitrate (34-0-0), P in the form of triple superphosphate (0-45-0), S in the form of gypsum ($CaSO_4.2H_2O$), combined sulfur 16.74 percent), and B in the form of borax ($Na_2B_4O_7.5H_2O$, boron equivalent 14.3 percent).

Fertilizers were applied by hand, using grass seeders to a 1/10-acre circular area (radius 37.2 feet) with the test tree at

the center. Application dates were the last week in October for the Road 1808 area and the first week in November for the Pringle Falls area.

For the Fort Rock location 48 dominant and codominant trees were selected. These trees were listed according to decreasing diameter and then divided into eight groups of six. Additional trees were selected in the Fort Rock area so a shrub vegetation removal treatment for the 1/10-acre area could be superimposed on the fertilizer treatments used in the other two central Oregon areas. In the treatment where shrubs were removed, the grasses (fescue, western needlegrass, and bottlebrush squirreltail) were undisturbed. Each of the eight replications then contained six treatments:

Abbreviation	*Treatment*
N0S	control
N0SR	not fertilized; shrubs removed
N1S	fertilized with 200, 100, 30, and 1.88 lbs/acre of N, P, S, and B; shrubs not removed
N1SR	fertilized with 200, 100, 30, and 1.88 lbs/acre N, P, S, and B; shrubs removed
N2S	fertilized with 400, 200, 60, and 3.75 lbs/acre of N, P, S, and B; shrubs not removed
N2SR	fertilized with 400, 200, 60, and 3.75 lbs/acre N, P, S, and B; shrubs removed

Fertilizer was applied with hand-operated grass seeders in March on a snow cover.

After the fourth growing season following treatment, tree heights in all areas were measured with a transit. Pretreatment heights were found by counting back four whorls from the tip and measuring the angle of elevation with the transit. Height growth data were subjected to analysis of variance. Diameter, basal area, and volume growth were determined and analyzed as previously described for the Sumpter Valley study.

The equation used to determine volume growth (equation 1) was derived from trees growing between the Fort Rock and Pringle Falls locations. Thus an assumption that bark thickness and form are very similar for the trees in this study and those from which the equation was determined ought to be reasonable because of the close proximity of the stands. A second assumption that fertilization does not result in form changes may not be true and is being tested.

Both basal area growth and volume growth were subjected to analysis of covariance, with initial basal area and volume as the respective covariants for each of the three study areas.

Results.--Yearly height growth averages for the Road 1808 and Pringle Falls areas were:

Area	*Treatment*	*Height growth*	*Range*
		Feet	
Road 1808	Control	1.1	0.6-1.4
	N1	1.6	.9-2.2
	N2	1.4	.9-2.0
Pringle Falls	Control	1.0	.8-1.3
	N1	1.4	1.0-1.9
	N2	1.4	1.1-1.9

Fertilization increased height growth for the Road 1808 area. Effect of treatment on height growth was almost but not quite significant at the 5-percent level for the Pringle Falls area. Lack of significance is attributed to erratic leader growth in some of the trees possibly caused by the insect *Eucosma sonomana*, the western pine shoot borer. For both areas, fertilization significantly increased diameter, basal area, and volume growth (table 4); and in the Pringle Falls area, the N2 level of fertilization caused a significant increase in diameter growth over the N1 level.

Height growth averages per year for the Fort Rock location were:

Treatment	*Height growth*	*Range*
	Feet	
N0S	1.1	0.5-1.4
N0SR	1.3	.6-1.8
N1S	1.5	1.1-1.8
N1SR	1.4	1.1-1.9
N2S	1.3	.8-1.8
N2SR	1.4	.8-2.3

The increase in height growth from fertilization was almost significant at the 5-percent probability level when all the trees at the Fort Rock location were analyzed together. Separate analysis of the different shrub treatments showed that fertilization did not influence height growth where shrubs were removed but increased height growth where shrubs were not removed. Again top damage was frequent in this area and may have confounded results.

Fertilization caused a significant increase in diameter and basal area growth; however, there was no difference between the N1 and N2 levels of fertilization (table 4). Shrub removal did not influence diameter or basal area growth. Effect of fertilization on volume growth was almost but not quite significant at the 5-percent level for the Fort Rock area (F value was 3.9076 with 1 and 34 degrees of freedom but 4.13 is needed at the 5-percent level of probability).

DISCUSSION

Some individuals familiar with ponderosa pine forests feel that water is so limiting that nutrient additions could not be beneficial. These studies show that in some thinned stands, nutrient additions do substantially increase individual tree growth, at least for a period of 4 years. The questions of duration of response, production on an area basis, possibilities of tree form changes with fertilization, and kinds and amounts of fertilizers necessary for maximum volume production cannot be answered at this time. Results here indicate that these questions are worthy of study for ponderosa pine forests in this region; consequently fertilization studies are continuing.

Speculation on some of these questions is possible at present, however. First, ring width and internodal lengths of fertilized trees had not started to decrease at the close of the first 4-year period, indicating duration of response is greater than 4 years. Further, response of individual trees was so large that increases in stand growth will probably be substantial. Also, response on an area basis will probably be greater on the sites with the most available moisture. Increases in volume production per tree were least in the Fort Rock area (table 4), the driest of the three central Oregon study locations, and the volume per unit area is probably less on this site also. Volume per unit area was greatest on the Road 1808 area, the site with the highest available soil moisture. Even though percent increase in growth for individual trees was larger at the Pringle Falls location, actual volume increase per tree is greatest for Road 1808; and increase in volume production per acre in response to fertilizer would be greatest on this site also.

There is indication that additions of S and P in combination with N would produce greater response than N alone in the Sumpter Valley area. Geist (1971) studied the response of orchardgrass to N, P, and S fertilization on seven soils from the Blue Mountain area north of Sumpter Valley. He found a significant N-S interaction for all soils and, for two soils, a significant response to P was obtained in combination with N and S. In six of the seven soils, addition of N alone produced little if any response.

Partial soil analyses (tables 1 and 3) are not presented here to correlate nutrient status with response to fertilization but to provide information that can be used in combination with later studies to make these correlations.

Lack of response to removal of shrub vegetation in the Fort Rock location is interesting as Barrett (1970) found that removal of all understory vegetation increased growth of thinned pine in a study on the Pringle Falls Experimental Forest. However, shrub cover is estimated to be between only 15 and 20 percent in the study area. Much of the understory at the Fort Rock location is fescue. This plant has a large root system and is quite competitive

(Larson and Schubert 1969). Gordon (1962) in California found that understory vegetation adversely affected growth of ponderosa and Jeffrey pine poles. Further, he concluded that perennial grass had a greater effect than broad-leaved plants.

An important finding here is that even though the grass was quite competitive, fertilization still increased diameter growth in an area of low available soil water. Observations during the growing seasons at the Fort Rock location indicated that the deer utilized the fescue on the fertilized areas very heavily, and possibilities of increasing the animal-carrying capacity as well as tree growth rates deserve investigation.

SUMMARY AND CONCLUSIONS

Four years after fertilizing 1/10-acre areas around individual ponderosa pine test trees in thinned ponderosa pine stands in central and eastern Oregon, the following results were obtained:

(1) Diameter and basal area growth of individual trees were substantially increased by fertilization.

(2) Height growth of individual trees was increased by fertilization where results were not confounded by top damage.

(3) Volume growth of individual trees was significantly increased by fertilization in all but the Fort Rock location. Even at this location, increase in volume growth due to fertilization approached significance at the 5-percent level.

These results indicate that further study to determine the amounts and kinds of elements necessary to produce maximum response and the duration of these responses is necessary.

It should be emphasized that these responses to fertilization were in connection with thinning, a proven tool for producing more usable wood. Considerable work is necessary before the use of fertilizers in standard pine management practice can be evaluated. This work is underway.

Table 1.--*Some chemical and physical properties of the A1 and A3 horizons of the soil at the Sumpter Valley site. The chemical analyses were performed by the Oregon State University soil testing laboratory according to the methods currently in use (Roberts et al. 1971). Texture was determined by the hydrometer method. Samples for analysis were taken from a pit in the approximate center of the study area*

Horizon	Depth	P	B	Extractable cations				Total N	O.M.[1/]	S	C.E.C.[2/]	Sand	Silt	Clay
				Ca	Mg	Na	K							
	In	*Ppm*		*Meq/100 gm*			*Ppm*	*---Percent---*		*Ppm*	*Meq/100 gm*	*------Percent------*		
A1	0-7	34	0.65	7.3	1.3	0.16	738	0.081	2.68	1.8	15.8	41	45	13
A3	7-14	16	.70	6.6	1.9	.18	582	.045	1.43	2.1	23.5	45	36	19

[1/] O.M. = organic matter.

[2/] C.E.C. = cation exchange capacity.

Table 2.--*Average annual diameter, basal area, and volume growth during a 4-year period after treatment for individual test trees in the Sumpter Valley area*

Study area	Mean starting values			Treatment	Annual growth values calculated using adjusted means obtained from covariant analysis				Increase in volume growth over control
	Diameter[1/]	Basal area	Volume		Diameter growth	Basal area growth		Volume growth	
	In	*Ft^2*	*Ft^3*		*In*	*Ft^2*	*Percent*	*Ft^3*	*---Percent----*
Sumpter Valley	10.0	0.556	9.66	Control	0.14	0.016	(2.9)	0.41 (4.2)	--
				N1	.21	.026	(4.6)	.59 (6.1)	45.2
				N2	.23	031	(5.5)	.68 (7.0)	66.6

[1/] This diameter is the actual mean diameter of the 24 test trees and is not the diameter derived from the average basal area.

Table 3.--*Some chemical and physical properties of the A1 and AC horizons of the soils from the three central Oregon study locations. The methods reported in the caption for table 1 were used for these analyses. Samples for the analyses were composites taken from at least 12 locations in the study area. Chemical analyses were performed at the Oregon State University soil testing laboratory (Roberts et al. 1971). Texture was determined by the hydrometer analysis*

Study locations	Horizon	Depth	P	B	Extractable cations				Total N	O.M.[1/]	S	C.E.C.[2/]	Sand	Silt	Clay
					Ca	Mg	Na	K							
		In	*Ppm*		*Meq/100 gm*			*Ppm*	*----Percent----*		*Ppm*	*Meq/100 gm*	*------Percent------*		
Fort Rock	A1	0-2	17	0.93	4.5	0.71	0.12	333	0.077	4.45	3.0	11.3	62	30	8
	AC	2-10	11	.49	4.2	.98	.18	333	.042	2.17	2.4	11.7	61	29	10
Pringle Falls	A1	0-2	28	.65	5.7	.71	.12	270	.119	8.85	1.8	14.95	64	19	17
	AC	2-12	18	.49	2.8	.60	.12	208	.028	2.86	1.0	9.9	63	28	9
Road 1808	A1	0-2	31	.58	1.9	.43	.10	156	.081	2.68	1.8	15.8	69	25	7
	AC	2-14	15	.46	2.3	.47	.12	156	.045	1.43	2.1	23.5	66	25	9

[1/] O.M. = organic matter.

[2/] C.E.C. = cation exchange capacity.

Table 4.--*Average annual diameter, basal area, and volume growth during a 4-year period after treatment for individual test trees in three central Oregon locations*

Study area	Mean starting values			Treatment	Annual growth values calculated using adjusted means obtained from covariant analysis					Percent increase in volume growth over control
	Diameter[1/]	Basal area	Volume		Diameter growth	Basal area growth		Volume growth		
	In	*Ft²*	*Ft³*		*In*	*Ft²*	*Percent*	*Ft³*	*---Percent----*	
Road 1808	14.6	1.258	31.43	Control	0.18	0.039	(3.1)	1.70	(5.4)	--
				N1	.27	.057	(4.5)	2.48	(7.9)	46.3
				N2	.30	.062	(4.9)	2.39	(7.6)	40.7
Pringle Falls	10.2	.591	11.02	Control	.23	.034	(5.8)	.88	(8.0)	--
				N1	.33	.042	(7.1)	1.12	(10.2)	27.5
				N2	.40	.046	(7.8)	1.30	(11.8)	47.5
Fort Rock	12.2	.836	13.25	Control (NOS)	.18	.029	(3.5)	.81	(6.1)	--
				NOSR	.19	.027	(3.2)	.83	(6.3)	3.3
				N1S	.24	.036	(4.3)	1.01	(7.6)	24.6
				N1SR	.24	.031	(3.7)	.87	(6.6)	8.2
				N2S	.25	.038	(4.6)	1.03	(7.8)	27.9
				N2SR	.25	.033	(3.9)	1.03	(7.8)	27.9

[1/] This diameter is the actual mean diameter of the test trees in each location and is not the diameter derived from the average basal area.

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